REMARKS/ARGUMENTS

Favorable reconsideration of the present application is respectfully requested.

New Claim 12 has been introduced. Basis for the new claim can be found throughout the original specification.

Briefly, the invention is directed to a method for electromagnetically forming a metallic member in which an end of the metallic member is expanded to form a flange having a predetermined shape. It is sometimes necessary to expand the end of a metallic member to form a flange having a specified shape, for example a curved shape to conform with the outer surface of another element to which it is to be bonded. Such a flange has several requirements, including precise shaping and strength retention. Strength retention, in particular, is a problem when *expanding* the end of a metallic member to form the flange since the expansion results in a reduction in the thickness of the material.

According to a feature of the invention set forth in the claims, the end of a metallic member in a mold is expanded to form a flange having a predetermined shape by inputting an instantaneous or single pulse of electromagnetic energy at the end of the metallic member. In contrast to applying the electrical energy over a time period, an instantaneous or single pulse of electromagnetic energy, sufficient for plastic deformation of the metallic member to expand and press the outer surface of the end of the metallic member onto a forming surface of the mold, forms the flange at or near room temperature, thereby work-hardening the flange (see the paragraph bridging pages 14-15, and page 17).

For example, according to the non-limiting embodiment illustrated in Figure 1, the metallic member may be an aluminum alloy tube positioned within a mold 3 having a forming surface 4. A current carrying coil 5 inserted within the tube 1 is energized by a high current generator which causes a single impulsive force to be applied to the metallic member 1. According to a feature of the invention, the impulse applied through the coil 5 should be

sufficient to plastically deform the metallic member 1 so as to expand and press an *outer* surface of the end of the metallic member 1 onto the forming surface 4 of the mold. Because this is done substantially instantaneously, the flange is deformed at near room temperature and is not softened. This causes work-hardening of the flange, which compensates for the thinning of the flange and helps assure sufficient strength in the subsequently formed joint. For example, it has been found that an amount of electrical energy of 8 kJ or more is sufficient to expand the flange and provide the desired work-hardening (see page 15).

Claims 1, 2, 7-9 and 11 stand rejected under 35 U.S.C. § 102 as being anticipated by U.S. patent 6,703,594 (Yablochnikov). Yablochnikov is directed to a method of impact welding which uses a high intensity magnetic pulse to *contract* a tube onto another member. More specifically, Yablochnikov is directed to a method for securing vehicular driveshafts which uses an electromagnetic field to force one component into another at very high velocities, thereby causing the components to be welded to one another upon impact (column 5, lines 46-50). For example, in Figure 9 of Yablochnikov, an inductor coil 48 is supplied with a high intensity energy spike which creates a strong magnetic field that exerts a force against the outer surface of a tube 12, thereby driving the driveshaft tube 12 **radially inward** (column 10, lines 40-44), causing the driveshaft tube to collapse about a neck 38. The collapsing portion of the driveshaft 12 accelerates to a high velocity, resulting in a high impact which is sufficient to weld the tube 12 onto the neck 38 (column 10, lines 53-63).

Applicant respectfully submits that none of the rejected claims is anticipated or rendered obvious by Yablochnikov. For example, Claim 1 recites "pressing the *outer* surface of the deformed end on the surface of a mold to form a flange having a predetermined shape at the end of the metallic member." Similarly, Claim 2 recites forming the flange "by only one time of the electromagnetic forming." In contrast, Yablochnikov teaches collapsing the driveshaft tube 12 onto the neck 38, so that it is the inner -- not outer -- surface of the tube

which is pressed onto another element. Moreover, since this difference results from the contraction (not expansion) of the collapsing prior art tube onto a part to which it is to be welded, it would not have been obvious for those skilled in the art to have instead pressed the outer surface of the tube in Yablochnikov.

New Claim 12 similarly recites inputting a single pulse of electromagnetic energy at the end of the metallic member "for plastic deformation of the metallic member to expand and press an outer surface of the end of the metallic member onto the forming surface of the mold." Again, the disclosure of Yablochnikov is for contraction, and not expansion, of an element.

This difference is significant, and renders the invention unobvious from Yablochnikov. As discussed above, the invention provides that the electromagnetic forming expands the end of a metallic member by the instantaneous input of sufficient energy for the plastic deformation of the member so as to form a flange having a predetermined shape. The flange is thus work-hardened to compensate for the reduction in thickness which inevitably results from *expansion* of the workpiece. This thinning problem does not arise in the collapsing which is performed in Yablochnikov. Instead, Yablochnikov provides a high intensity pulse in order to achieve an impact weld of the driveshaft collapsing on the neck 38. There is no teaching of the desirability of work-hardening in Yablochnikov, or any suggestion for applying a single high energy pulse in the absence of the desire to create an impact weld. Applicant therefore respectfully submits that the invention is not obvious from Yablochnikov and that Claims 1, 2, 7-9, 11 and 12 clearly define over Yablochnikov.

Claims 1-3, 5, and 8-11 stand rejected under 35 U.S.C. § 102 as being anticipated by either U.S. patent 6,484,384 (Gibson et al.) or U.S. patent 6,050,120 (Daehn et al.). These rejections are also respectfully traversed.

Gibson is directed to a method of forming a driveshaft which is axially collapsible, in which tube portions 23 and 24 are joined at an overlapped region 26. The inner and outer tube portions can be joined by expanding the inner tube 23 outwardly in conformance with the end of the outer tube 24 by methods including electromagnetic pulse forming (column 5, lines 1-5).

However, the expansion of the inner tube 23 in Gibson et al. expands the end thereof onto the outer tube, and not onto "the surface of a mold" (Claim 1) or "onto the forming surface of" a mold (Claim 12). Additionally, there is no disclosure or inherent requirement in Gibson et al. that the electromagnetic pulse forming should be performed "by instantly inputting an electromagnetic energy for plastic deformation (Claim 1) or forming the flange "by only one time of the electromagnetic forming" (Claim 2) or "inputting a single pulse of electromagnetic energy at the end of the metallic member, the pulse of electromagnetic energy being sufficient for plastic deformation of the metallic member to expand and press the outer surface of the end of the metallic member onto the forming surface of the mold" (Claim 12). Instead, the pulse forming of Gibson could be performed by a stepwise plurality of low power pulses (e.g., as is described in the paragraph bridging pages 4-5 of the present specification), which would not provide work-hardening.

Similarly, there is no evidence in Gibson et al. that the electromagnetic forming process disclosed therein includes electrical energy input at one time of 8 kJ or more (Claim 4). The Examiner has alleged that this would nonetheless have been obvious to one of ordinary skill in the art based upon "routine experimentation." However, any "routine experimentation" would only have identified the minimum electrical energy required to provide forming, *per se*, not an amount necessary to provide forming instantaneously, or in a single pulse, so as to work-harden the flange. Without a teaching of the desirability of electromagnetic forming instantaneously, or in a single pulse, so as to work-harden the

flange, those skilled in art would not have been motivated to have performed "routine experimentation" for determining the energy input required to achieve this undisclosed result.

As for Daehn et al., Figure 13b of this reference discloses using an electromagnetic forming coil to expand an annular bead along the length of a tube. However, here again there is no description that this should be done by inputting an instantaneous or single pulse of electromagnetic energy so as to provide work-hardening. Daehn et al. is therefore no more material than is Gibson et al. with respect to the present claims.

Claim 6 has been amended responsive to the rejection found in paragraph 1 of the Office Action, which is believed to be moot.

Applicant therefore believes that the present application is in a condition for allowance and respectfully solicits an early notice of allowability.

Respectfully submitted,

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